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(54) Abstract Title
Disc brake lock

(57) An anti-theft device 2,4 for vehicles equipped with a disc brake 50 and a handlebar 62, e.g. motorcycle, comprises: a lock mechanism 8a,8b for locking the device to a brake disc 50 via a perforation or opening 52 of the disc; and coupling means 28 for fastening the device to an end of a handlebar 62. The device may comprise first and second separable parts 2,4 which are lockable with respect to each other. One part 4 may be in the form of a pin 40 which terminates in a head 44 and which is provided with a notch or peripheral groove 48. The other part may be in the form of a main body 2 which comprises a recess 6 for receiving the pin 40 after it has been passed through an opening 52 of the disc, and a locking mechanism 8a,8b,10,14-22 for lockably engaging the notch or groove 48. In one embodiment the device is secured to the handlebar by a handlebar adaptor 60. The adaptor comprises a sleeve portion 64 which is secured within an end portion of the handlebar. In a further embodiment the device may be fitted with an alarm system [see figures. 13,14].

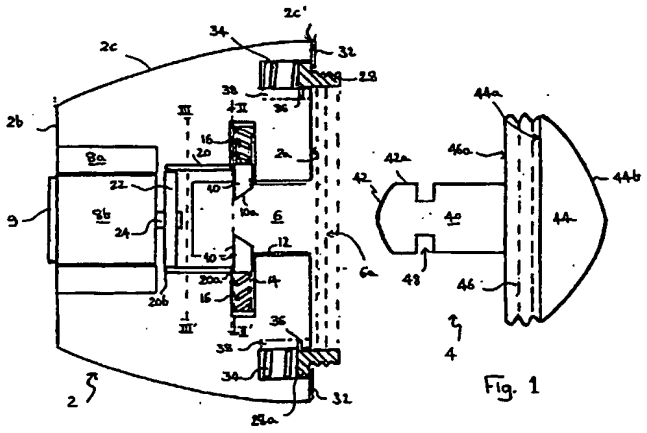

Fig. 1

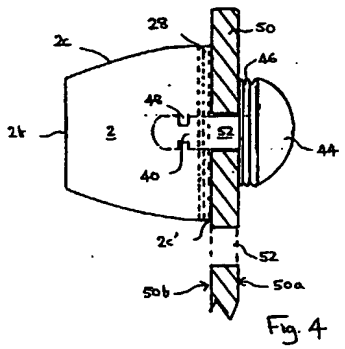

Fig. 4

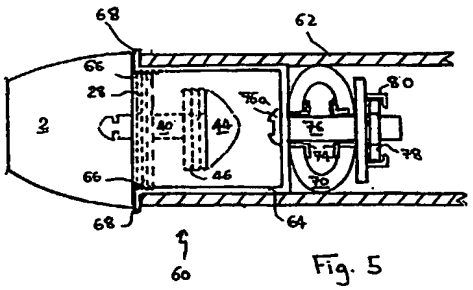

Fig. 5

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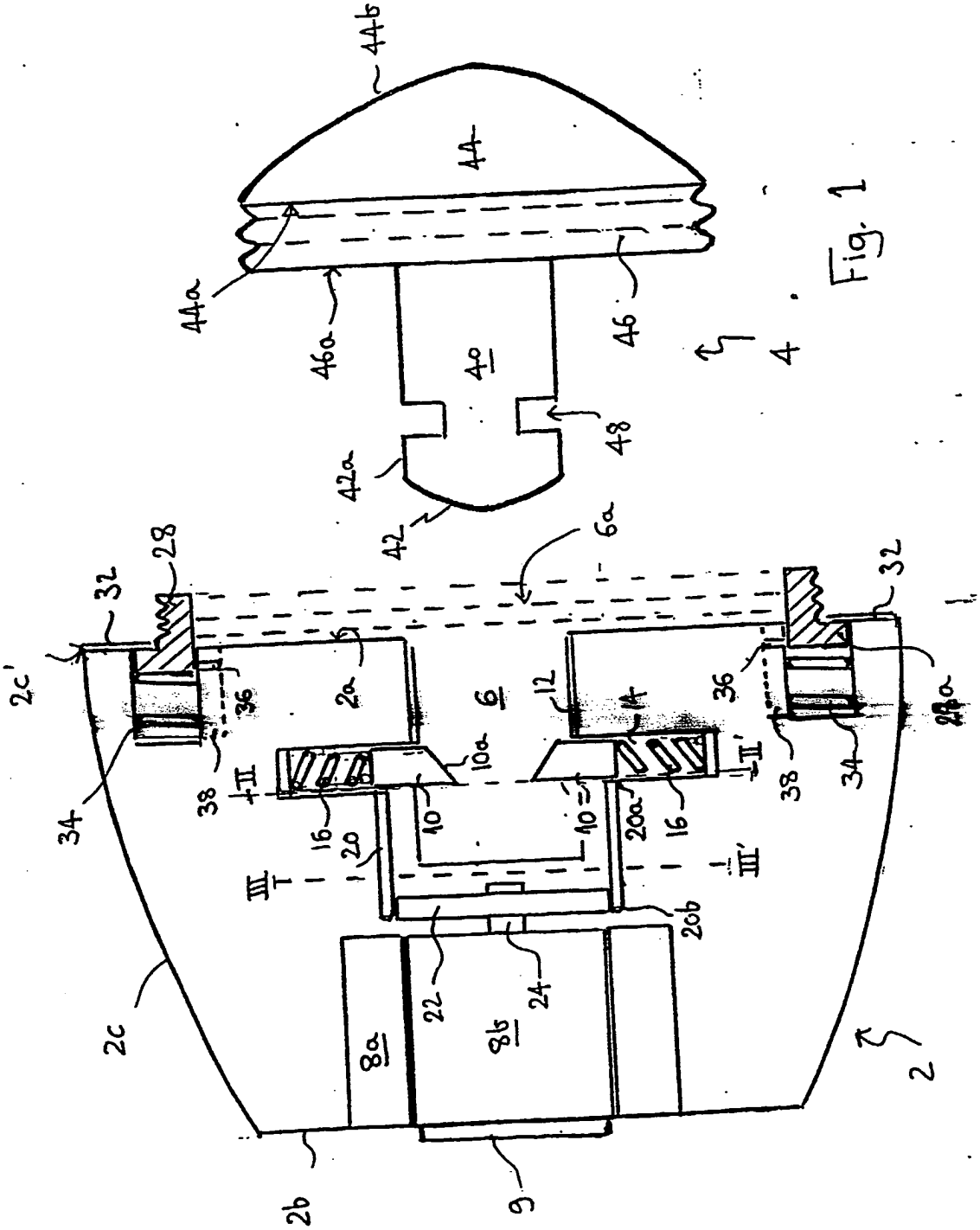

44b
44
44a
46a
40
46
48
42a
42
4
6a
28
32
2c'
36
2a
6
12
14
10a
38
34
16
20
10
20a
III
III'
II
II'
20b
22
24
8a
8b
2c
2b
9
2

Fig. 1

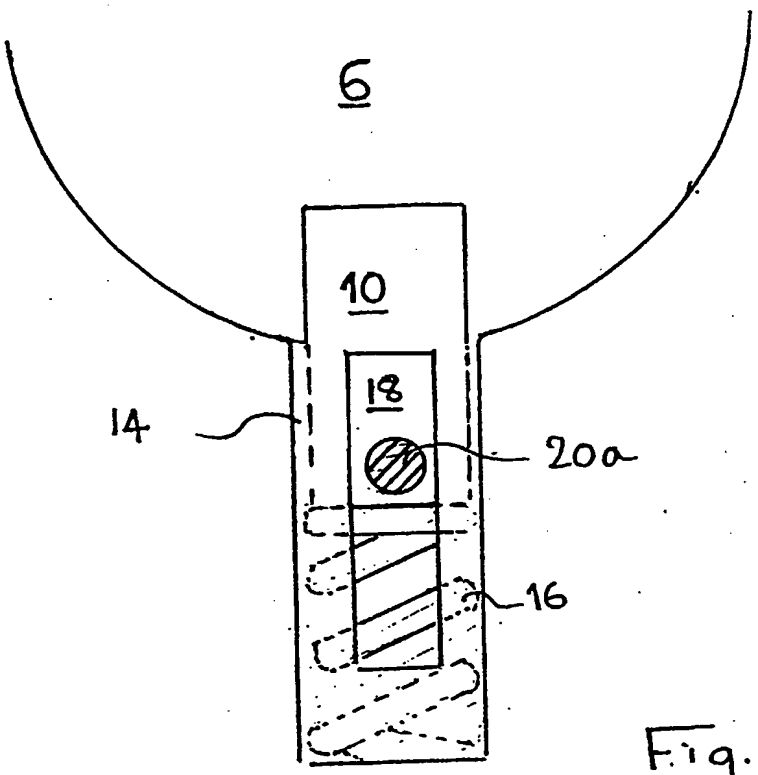


Fig. 2

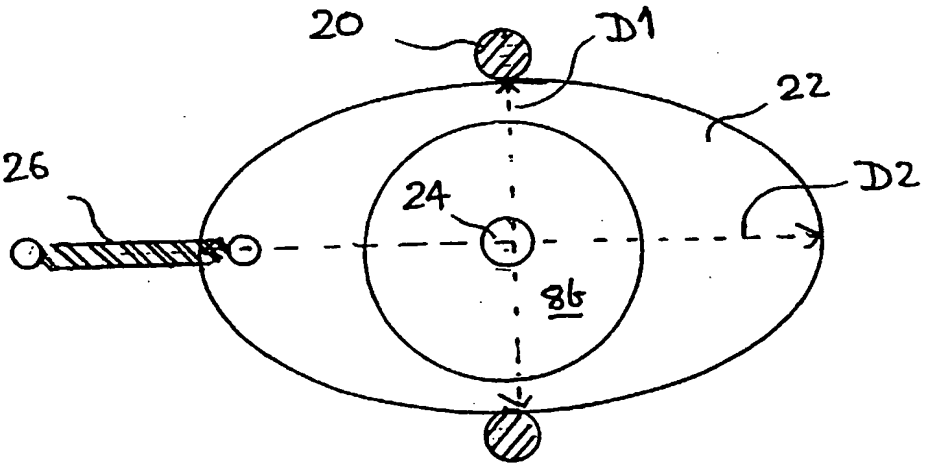


Fig. 3

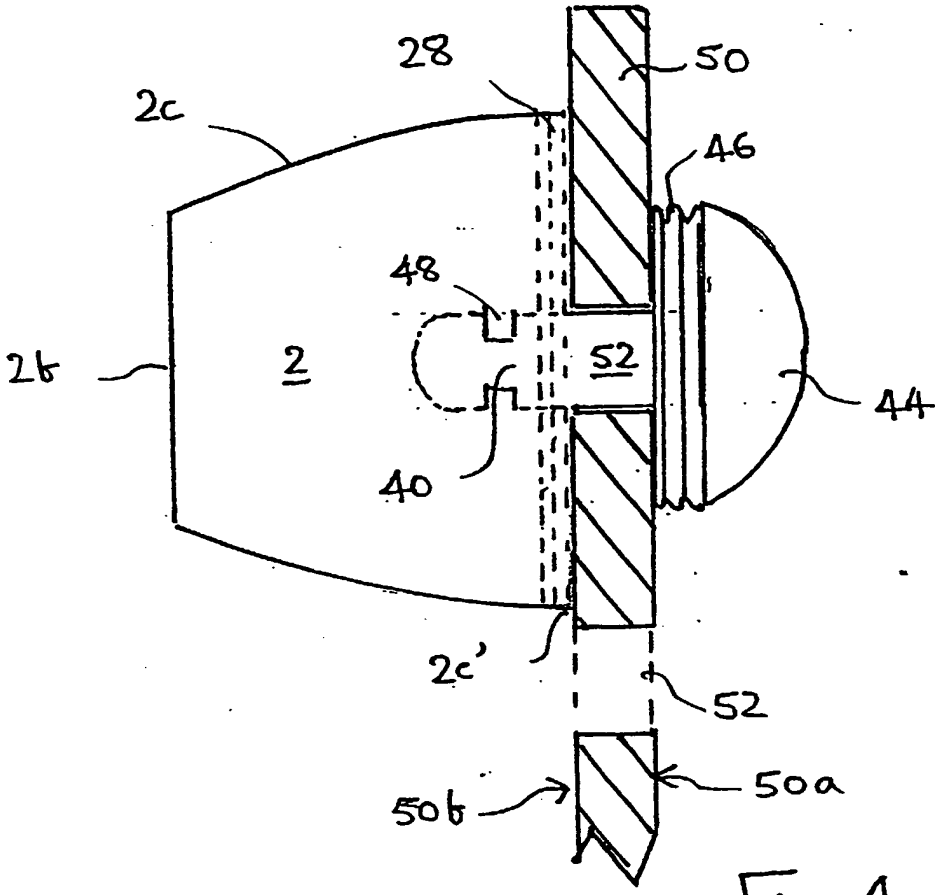

28
50
2c
46
48
2b
2
52
44
40
2c'
52
50a
50b

Fig. 4

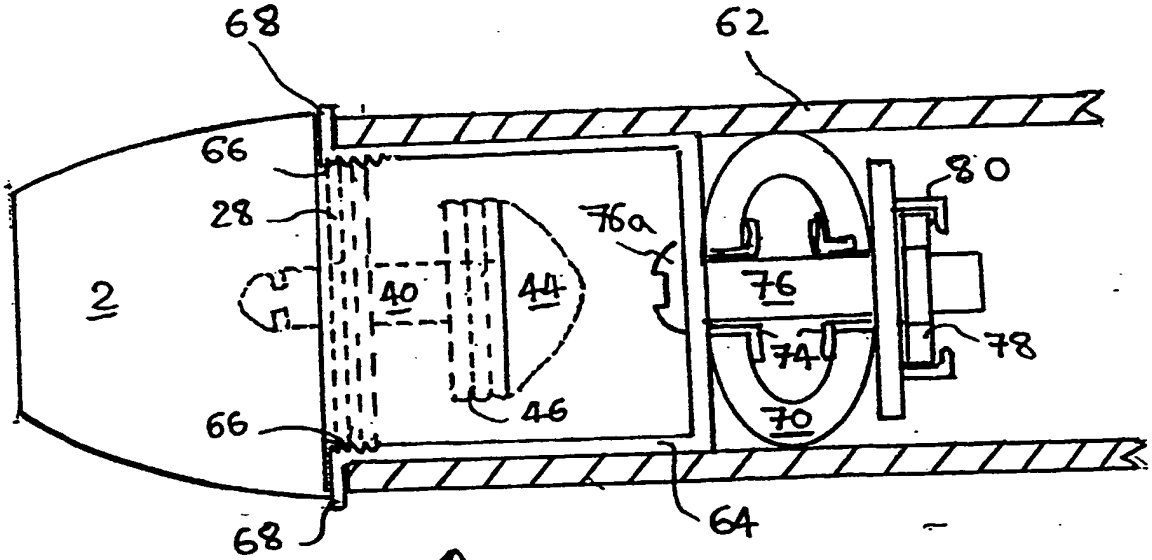

68
62
66
80
28
76a
2
40
44
76
74
78
46
66
70
64
68
60

Fig. 5

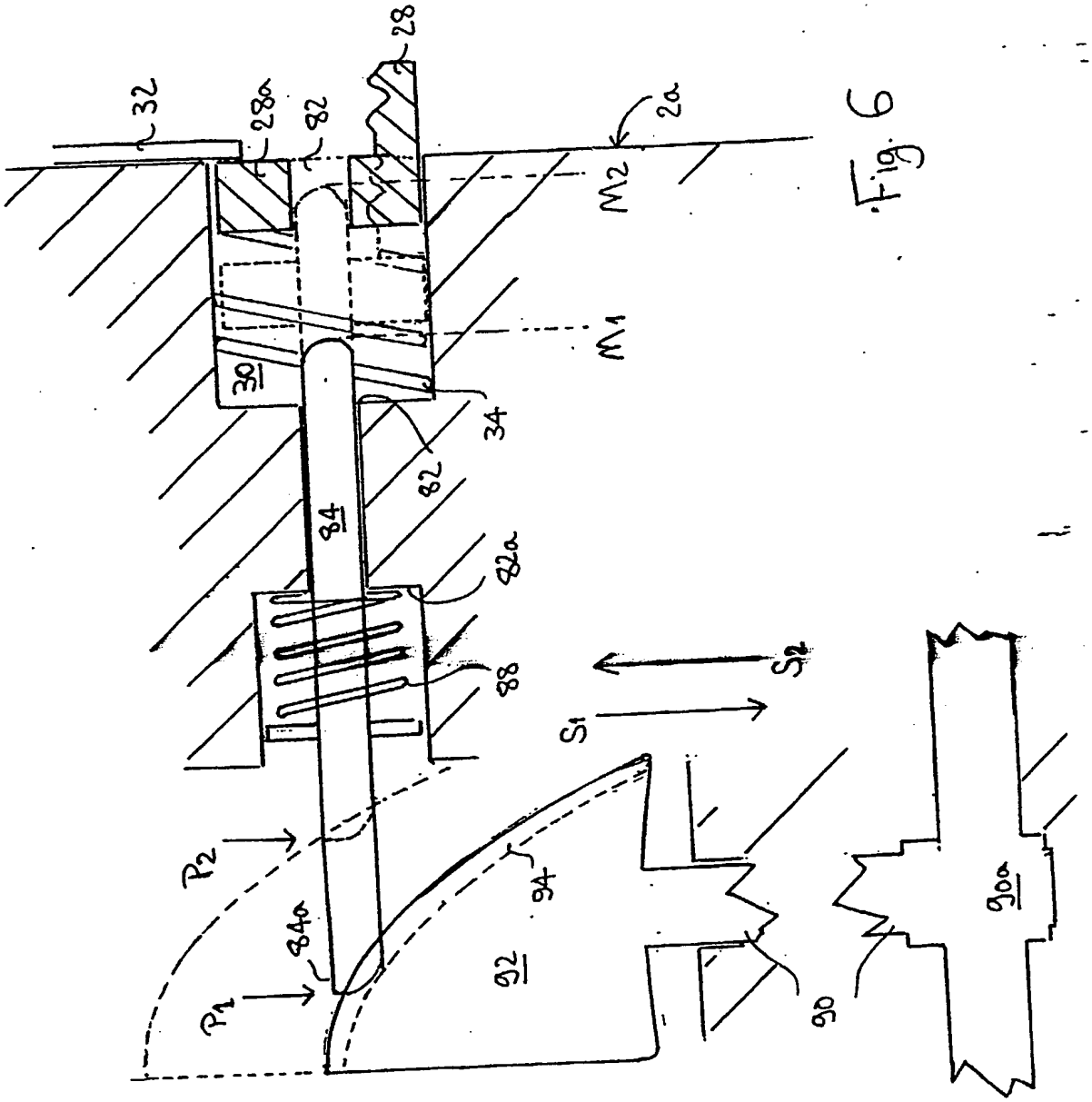


Fig. 6

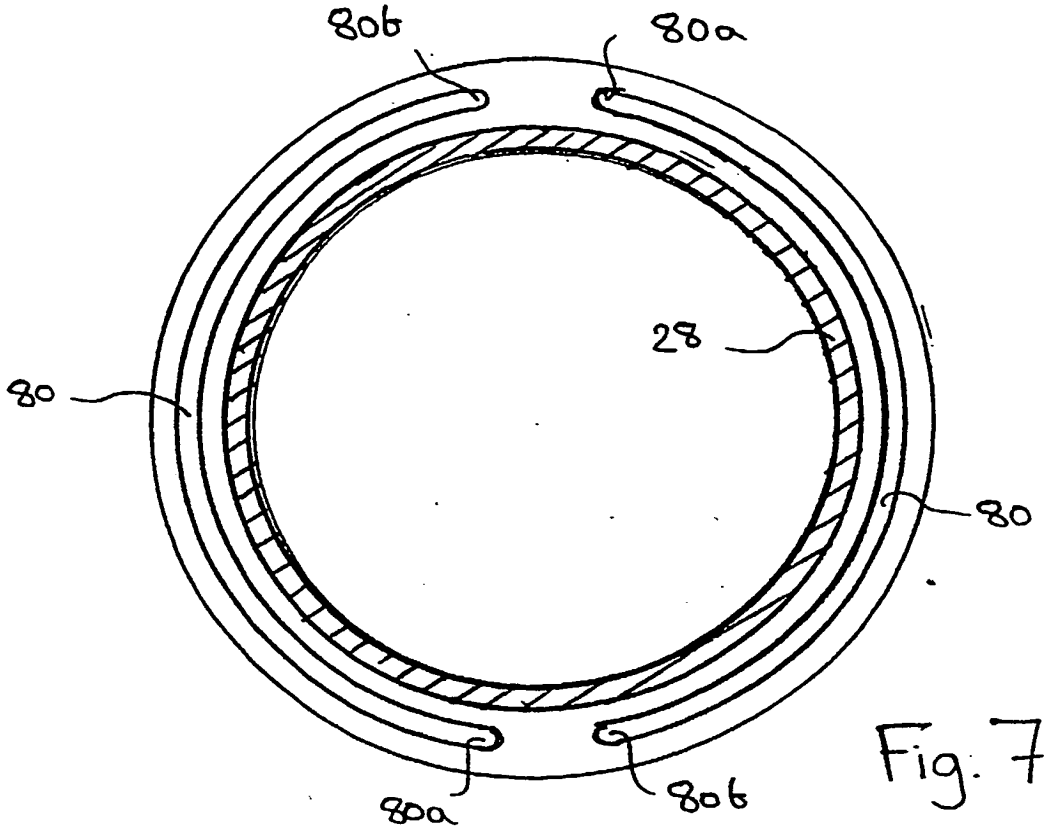
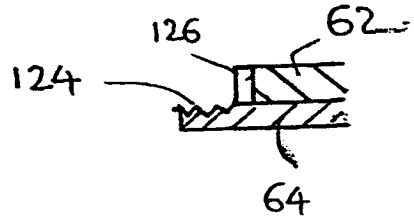


Fig. 7



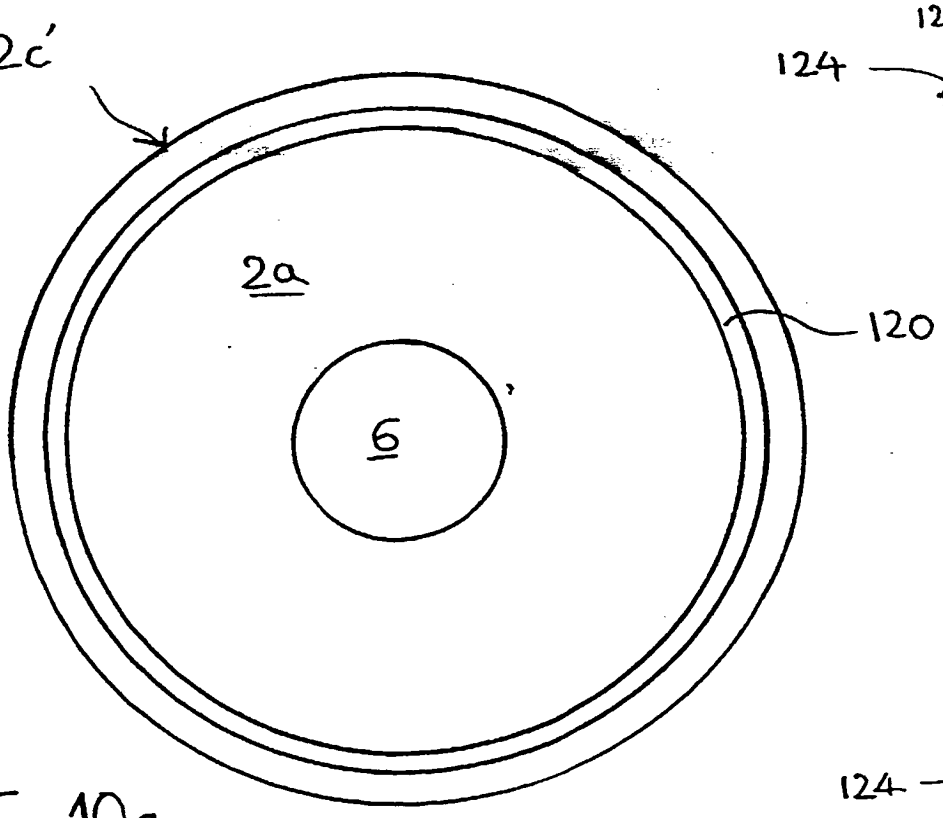


Fig. 10a

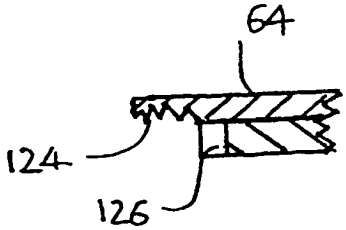


Fig. 10b

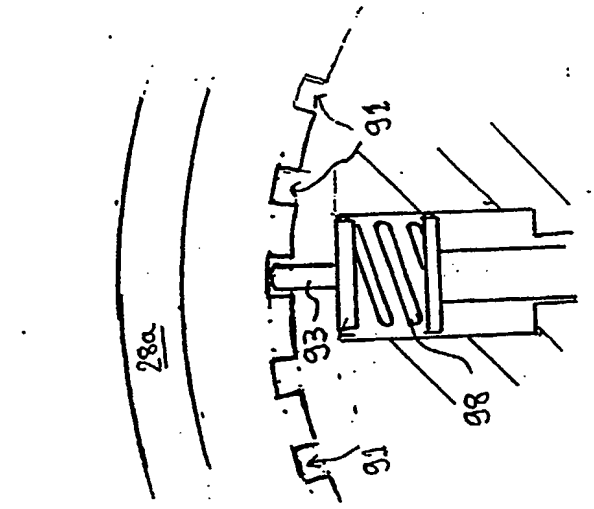


Fig. 8b

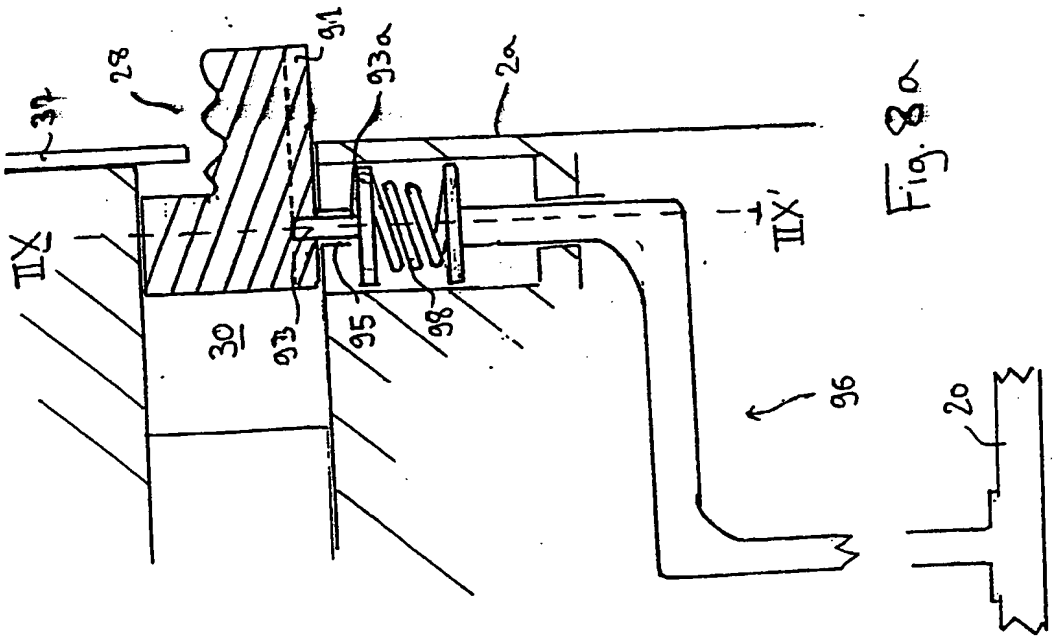
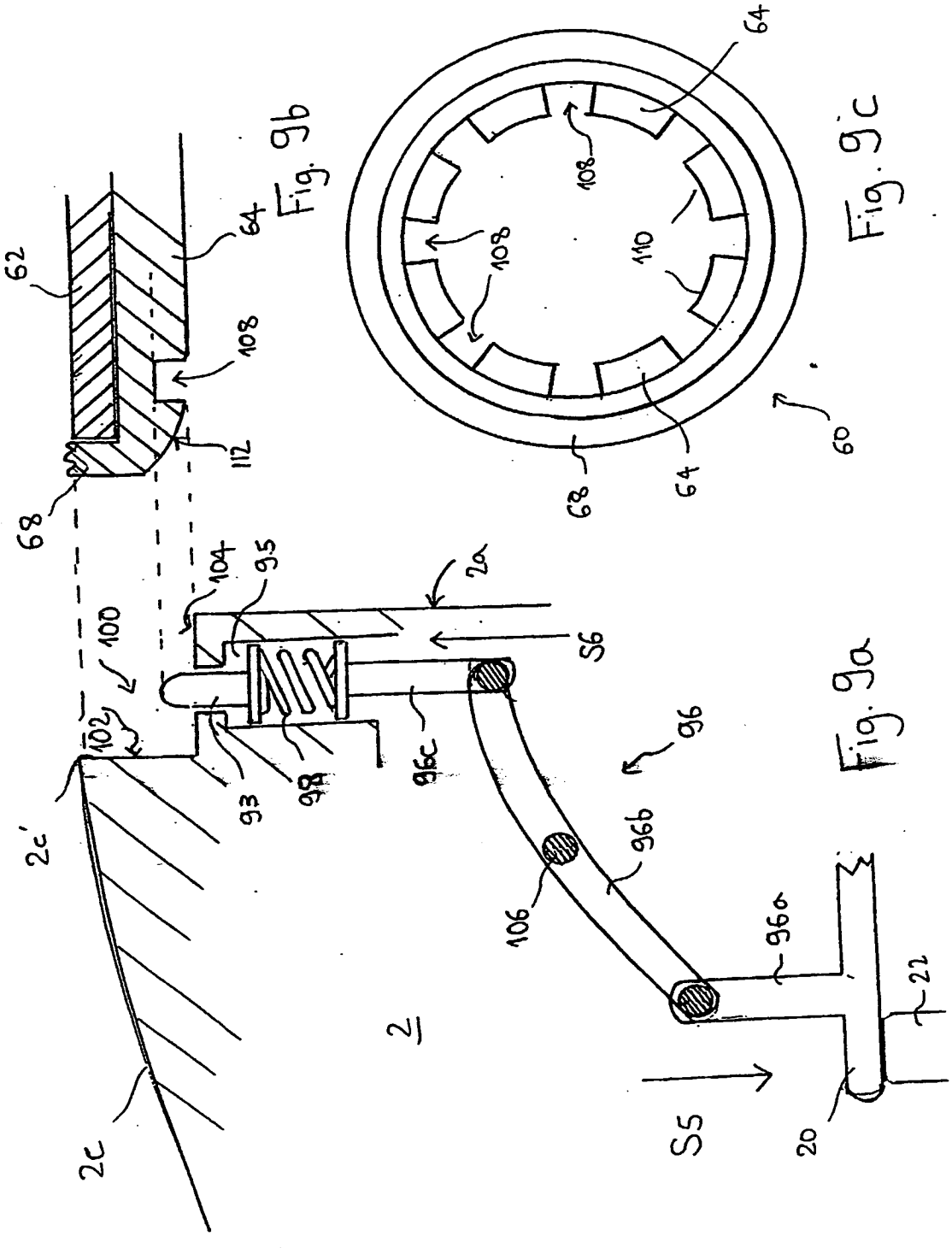
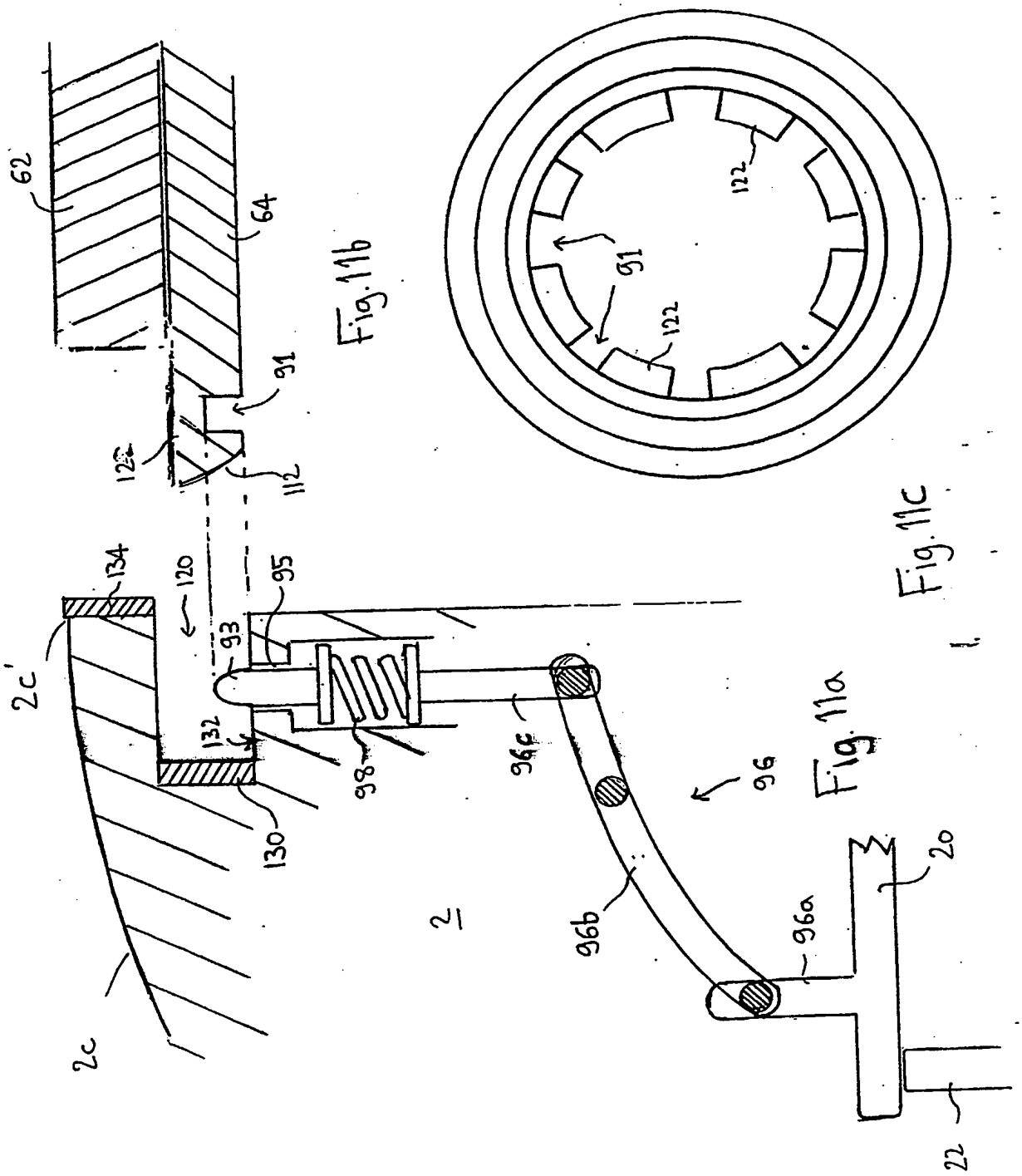


Fig. 8a


64
108
108
110
60
68
64
Fig. 9c
62
64
108
112
68
Fig. 9b
104
95
2a
100
S6
102
96
96c
93
98
96b
106
2c'
96a
22
2
S5
20
2c
Fig. 9a


62
64
91
122
112
Fig. 11b
122
91
122
Fig. 11c
134
120
95
93
2c'
132
98
96c
96
Fig. 11a
130
2
96b
96a
20
2c
22

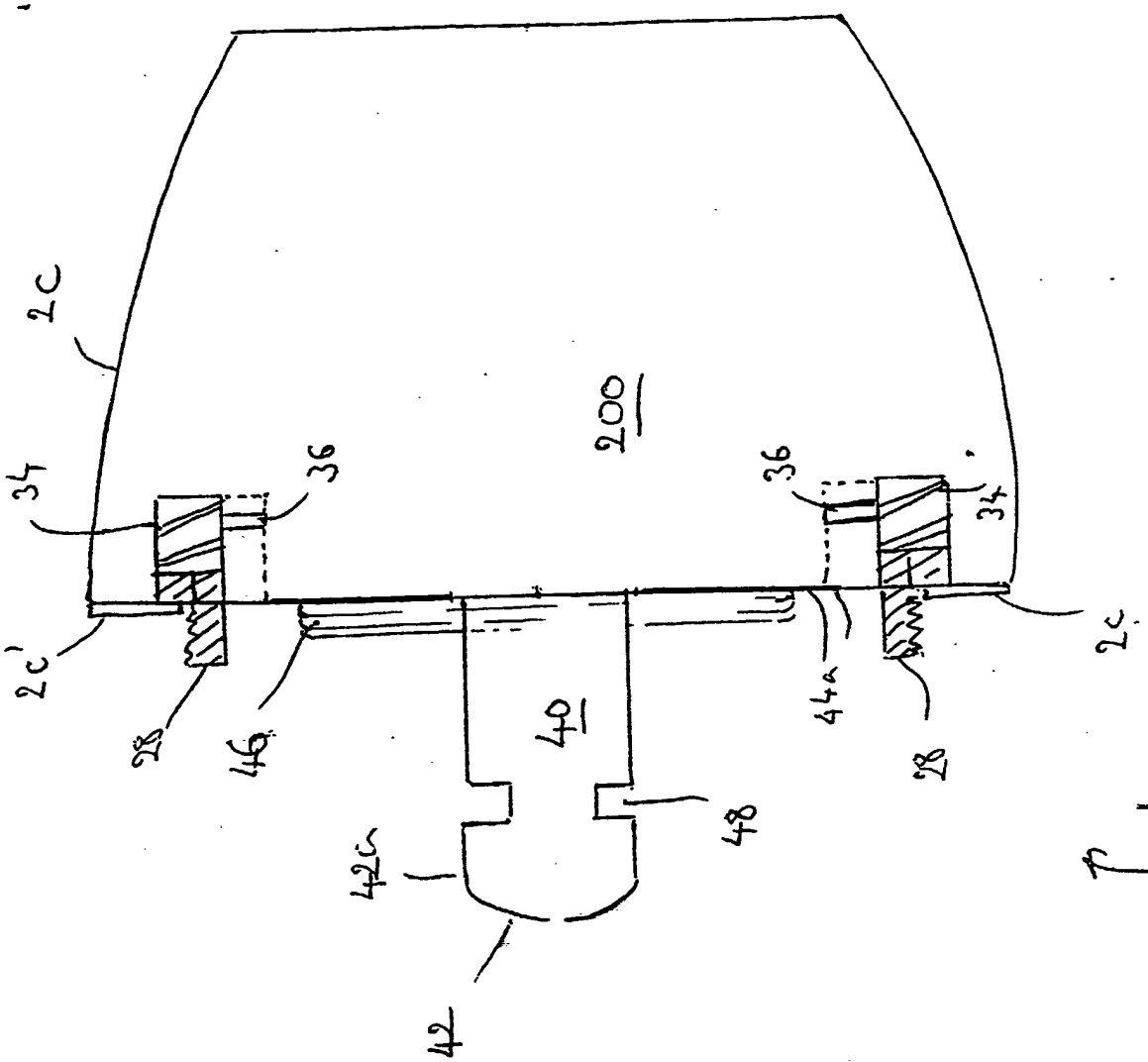


FIG. 12

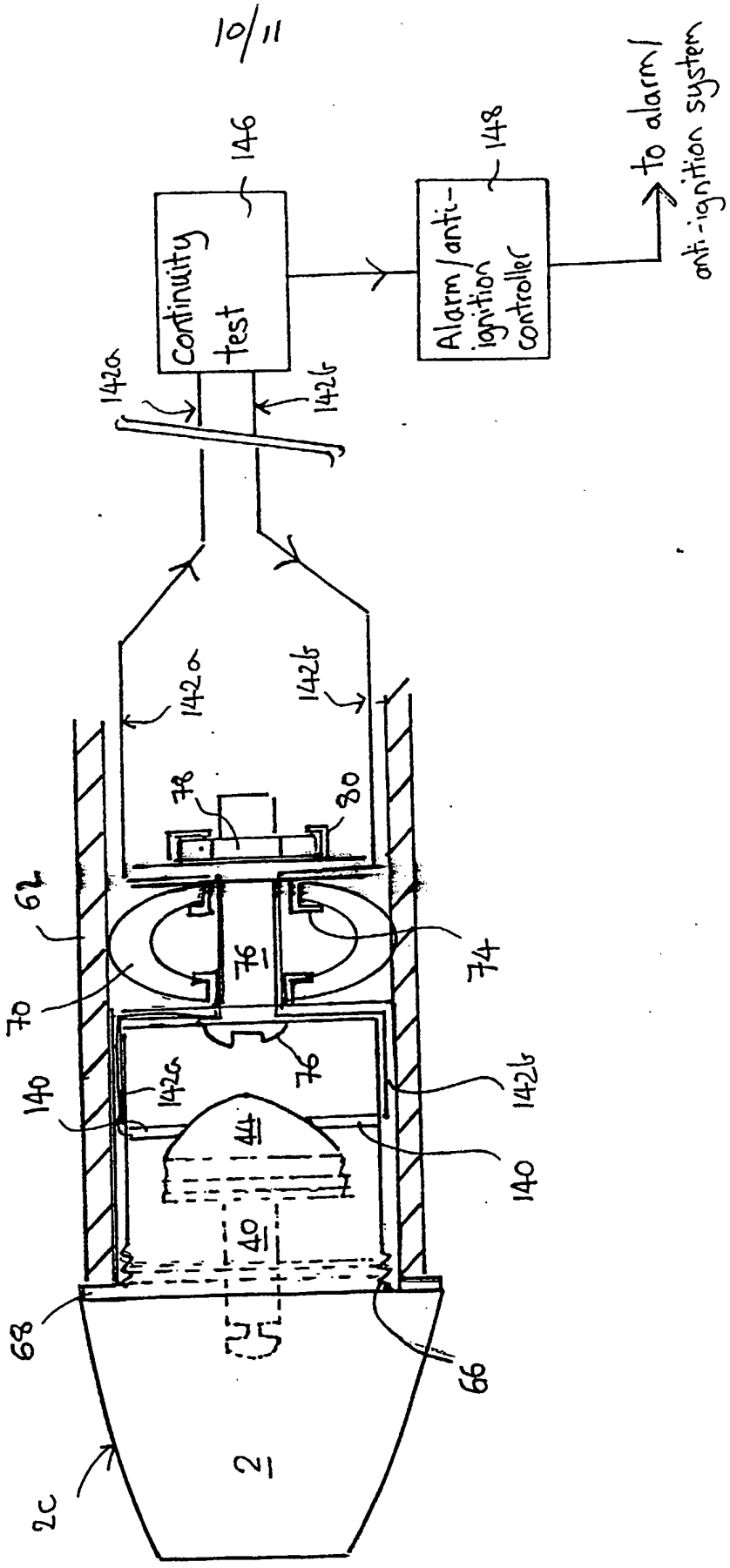

146
Continuity test
148
Alarm/anti-ignition controller
to alarm/ anti-ignition system
142a
142b
78
80
62
70
76
74
140
44
40
68
66
2
2c

Fig. 13

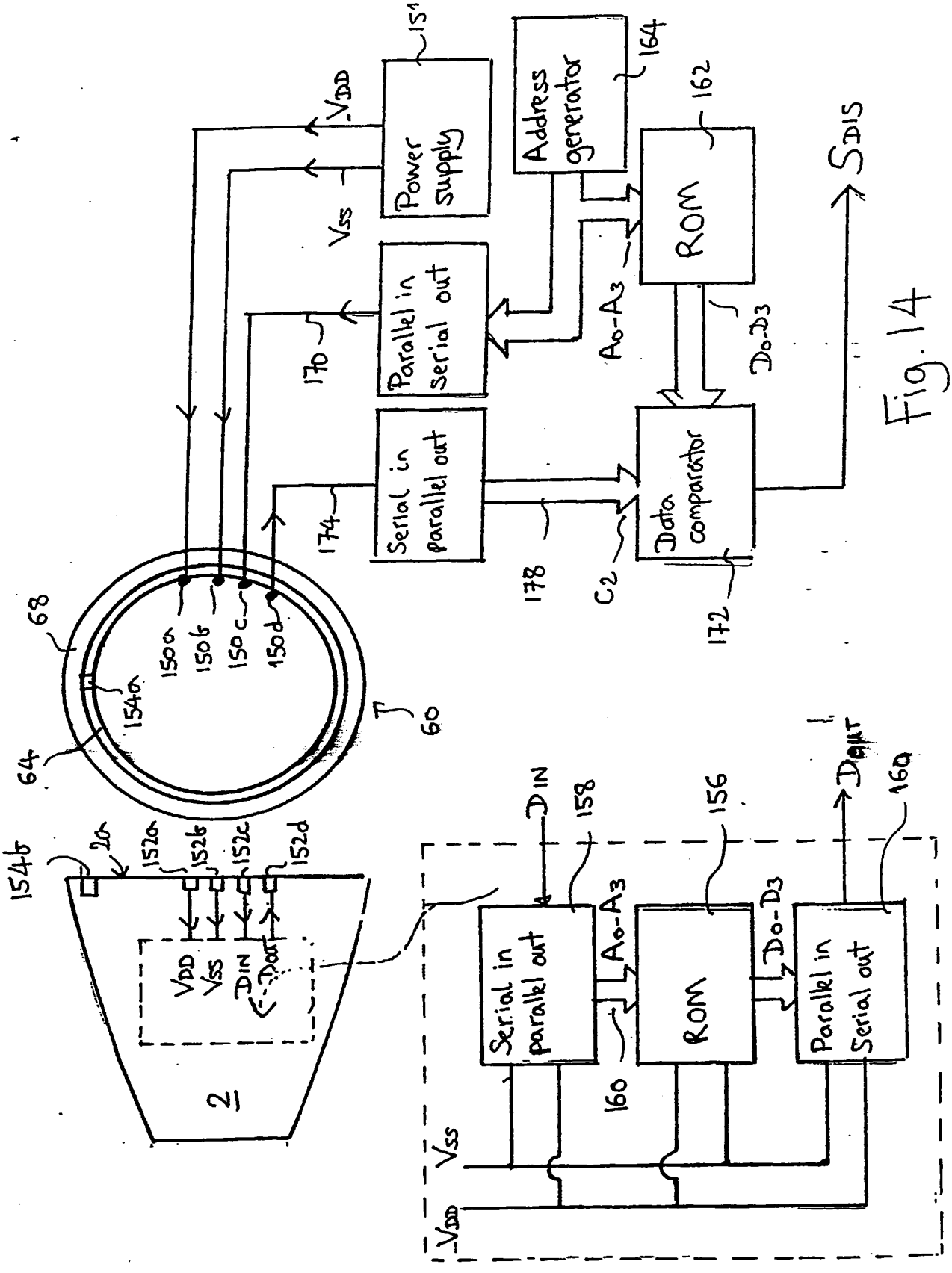

Power supply
Address generator
ROM
Parallel in serial out
Serial in parallel out
Data comparator
Vdd
Vss
A0-A3
D0-D3
SDIS
DIN
DOUT
68
64
60
150a
150b
150c
150d
154a
154b
152a
152b
152c
152d
20
2
156
158
160
162
164
170
172
174
178
C2

Fig. 14

2371079

Anti-theft device for vehicle equipped with a handlebar and disk brake

The present invention relates to an anti-theft device suitable for motor vehicles such as motorcycles, tricycles and scooters, which are equipped with at least one disk brake having perforations or openings at the disk support structure. More specifically, the invention relates a so-called disk lock engageable into one of the disk perforations or openings to lock onto the disk and thereby prevent free rotation of the associated wheel.

Such disk locks are now used extensively, especially as virtually all modern motorcycles and a growing number of scooters are equipped, at least at the front, with perforated brake disks.

Typically, a disk lock is configured as a single unit containing an open-ended slot designed to receive the brake disk. For example, the slot may be formed by a thick metal bar folded into a narrow U. A retractable pin associated with a locking mechanism is provided at one of the confronting faces of the slot, near the open end. In the locked position, the pin projects across the slot and into a blind bore on the other confronting surface.

In order to set the device into its working position, the open end of the slot is aligned with the peripheral edge of the brake disk and moved towards the centre of the latter until one the disk perforations is aligned with the axis of the pin. The lock mechanism is then activated to cause the pin to pass through the disk perforation or opening and into the blind bore, whereupon the device is physically coupled to the brake disk. In this way, it obstructs the passage between the brake disk and the brake callipers (attached to the wheel forks), or between the forks themselves.

Disk locks are advantageous owing to their small size and weight in comparison with ~~cable locks or rigid U-shaped devices with a lockable closure member~~. However, they suffer from a number of drawbacks.

Firstly, the slot formed in the body of the device makes it very easy to insert a crowbar or the like to prise apart the confronting faces and thus free the pin from the brake disk. This is particularly true of devices where slot is formed by a folded metal bar, since the slot is then significantly wider than the thickness of the brake disk. Moreover, there is invariably an open space left between the closed end of the slot and the edge of the brake disk, again leaving access for a forced opening.

Secondly, because a disk lock can allow the wheel to rotate freely until it comes into contact with the brake calliper or fork, there is a risk of serious damage or injury if the user starts the vehicle while having forgotten to remove the device. In such a case, the vehicle can accelerate quickly over the two-thirds of a turn or so of free rotation before being abruptly stopped. To help reduce this problem, most manufacturers make their disk locks brightly coloured to attract attention and sometimes provide stickers with a cautionary message to place within sight of the rider. However, these means for drawing attention are quickly ignored over time and lose their effectiveness.

Thirdly, as with the majority of locking devices provided as a separate accessory, there is the problem of stowage on the vehicle when not in use. If some disk locks are sufficiently small to be carried on the person, this is never desirable from a safety point of view in case of impact. Larger disk locks are normally sufficiently compact to be stowed under the saddle with some machines, but access is then more time consuming and complicated. These stowage problems are even greater with the other types of anti-theft devices mentioned above.

For these reasons, many users take with them and use an anti-theft device only when they judge it necessary, for instance if it is envisaged to park the vehicle unattended over a long period or in a high-risk environment. As a result, vehicles are sometimes parked without a lock whilst being exposed to a non-negligible risk.

The present invention was made with these considerations in mind by providing an anti-theft device for a vehicle equipped with handlebar means and at least one brake disk presenting perforations therein or openings at the disk support structure, the device comprising locking means for locking onto a brake disk via an aforementioned perforation or opening and characterised in that it further comprises means for fastening onto at least one end of the handlebar means so as to form at one end-piece for the latter.

The anti-theft device according to the invention therefore has a dual function: in addition to blocking the brake disk, it serves as an end-piece for the handlebar. The two functions do not interfere with each other since the handlebar end-piece is essentially a requirement for when the vehicle is in motion.

A handlebar end-piece - or its absence - is always immediately noticeable upon mounting the vehicle since it is situated right next to the hand, and most times slightly in contact with the latter. In this way, the rider need not make any conscious effort to check that the device has been removed from its locking position, or has not dropped, before setting off.

Because the device according to the invention is stowed in a functional position, it is always carried along and thus ready for use to lock the bike

In the preferred embodiments, the anti-theft device according to the invention is composed of first and second separable parts which are lockable with respect to each other through a perforation or opening of the brake disk.

Such a configuration is very secure, since the two separable sections can be brought close to the respective faces of the brake disk, thereby giving no possibility to insert a forcing tool.

Also, it is very easy to install the device when it has a two-piece structure; all that is required is to select a perforation or opening within reach on the brake disk and to engage the two pieces on either side. There are no structural parts that can obscure from view one of the disk faces, as with disk locks having a slot structure.

Preferably, the first and second separable parts are respectively comprised of male and female mating members, the male mating member comprising an element adapted to pass through the perforation or opening of the brake disk and the female mating member comprising

a lock mechanism arranged to secure the male mating member in engagement therewith when in the locked state.

The female mating member and the male mating member can be respecively incorporated in a first endpiece and in a second end piece.

The male mating member can be in the form of a pin terminated by a head at its distal end and provided with a notch or peripheral groove at its proximal end, while the female mating member is in the form of a main body portion that contains a recess for receiving the pin and a lock mechanism cooperating with catch means within a recess for lockably engaging with the notch or peripheral groove when in a locked state.

The pin can easily be passed through a chosen brake disk perforation and the main body portion subsequently engaged with the portion of the pin that projects through the disk.

Advantageously, the respective faces of the male and female mating members that confront the brake disk are configured to be flush against the respective sides of the latter.

This ensures there is no sizeable gap between the respective portions facing each side of the brake disk, and consequently there is no possibility of inserting a forcing tool such as a crowbar between either of male and female members and the brake disk.

Advantageously, the anti-theft device comprises resilient means to impart pressing contact against the sides of the brake when in the locked state. In this way, it can be assured that there is no gap between the brake disk and the device even when accommodating for different brake disk thicknesses. In preferred embodiments of the invention, the resilient means are in the form of a spring element having resilience along its principal axis, such as a coil spring or a profiled ring formed of spring plate, at the end of one or both of the male and female mating members.

~~The invention allows for many different approaches~~ for mounting the anti-theft device onto the handlebar to provide the function of an ~~end-piece. All mounting arrangements~~ currently used with classical end-pieces can be used, including expansion mounts, screw mounts and bayonet mounts.

According to one embodiment of the invention, there is provided a mounting adaptor fixable inside the handlebar for securing the anti-theft device. The mounting adaptor preferably comprises a cylindrical sleeve insertable inside the handlebar and means for anchoring onto the internal surface of the latter. The anchoring means can be an expansion joint, widely used in the art for securing classical handlebar end-pieces.

The cylindrical sleeve of the adaptor and the anti-theft device are each provided with mutually complementary coupling means to allow a screw mount or a bayonet mount, for example.

In some embodiments of the invention, the coupling means of the anti-theft device project from the face turned towards the handlebar (front face) and are retractable from that face so as to allow the latter to be flush against the brake disk.

A friction mount between the anti-theft device and the mounting adaptor can also be envisaged.

Alternatively, the anti-theft device can be mountable directly on the handlebar without recourse to a separate adaptor. For example, a thread can be tapped on the inner or outer surface of the handlebar for screw-mounting the device. It is also possible to provide a bayonet or other corresponding fixture directly on the end of the handlebar.

According to another embodiment of the invention, the locking means of the anti-theft device is also operative to lock the latter onto complementary locking elements on the handlebar adaptor or handlebar, whereby it can be lockably mounted onto the latter using the same lock as for locking onto the brake disk.

For example, if the anti-theft device uses a classical lock barrel mechanism as exists in padlocks, the rotation of the barrel by insertion of an appropriate key or combination can be made to move a locking means at the level of the anti-theft device into a fixing engagement with a complementary mating means at the level of the sleeve or handlebar.

In one embodiment, the anti-theft device has handlebar coupling means, e.g. a threaded ring, which engages with the handlebar or handlebar adaptor by effecting a predetermined movement, e.g. rotation, and further comprises linking means which cooperate with the lock mechanism for selectively engaging and disengaging the handlebar coupling means to an accessible part of the anti-theft device, e.g. the main body portion, so that the latter can impart the predetermined movement to the handlebar coupling means only when the lock is in the unlocked state.

In another embodiment, an equivalent technical effect is achieved by providing the anti-theft device with handlebar coupling means in the form of a set of male elements which are mechanically coupled to the lock and configured to be able to project and fasten into corresponding female elements in the handlebar or handlebar adaptor and to retract from the latter when the lock is respectively in the locked and unlocked state.

In either of the two above embodiments, the handlebar coupling means of the anti-theft device can be arranged to be recessed from the face turned towards the handlebar - and which confronts the brake disk - either permanently or when the aforementioned face is pressed against the brake disk, e.g. by being retractable. In this way, the sidewall of the device extends to the aforementioned face without passing through an indent or shoulder portion.

According to another aspect of the invention, there are provided means for actively signalling if the anti-theft device is not positioned as a handlebar end-piece when attempting to start the vehicle.

In a first embodiment incorporating this aspect of the invention, the anti-theft device cooperates with an alarm and/or anti-ignition system on the vehicle by closing a circuit connection formed at an end of the handlebar or handlebar adaptor to which the anti-theft device is to be received. The connection is adapted to enable operation the alarm device all the while the anti-theft is not positioned – or not positioned correctly - on the handlebar or handlebar adaptor.

The cooperation of the anti-theft device with a vehicle burglar alarm/anti-ignition system thus not only provides additional security for the vehicle, but also actively warns the

user when the anti-theft device is not removed from the brake disk when trying to start off. This active warning is supplementary to the clearly apparent visual indication which results from giving anti-theft device the additional function as a handlebar end-piece.

The circuit connection between the alarm and the anti-theft device can be achieved by various techniques. In a simple embodiment, a wire link is provided inside the handlebar up to contact means at or near the end where the anti-theft device is to be received. The latter is provided with contacting means – which can be simply a conductive portion inside or close to the handlebar for acting on the contact means so as to make or break a signal path along the wire.

A more foolproof way of controlling the inhibition of the ignition or alarm can be achieved by providing the anti-theft device according to the invention with a code carrier or code generator which cooperates with an alarm system on the vehicle.

According to the present invention, the coding means can be a semiconductor memory or a set of specially configured electrical contacts at the level of the end-piece. The coding means can be arranged to transmit the stored code to the alarm system, and thereby disable the alarm and/or enable the ignition only when the device is correctly installed as an end-piece of the handlebar.

The coded information can also be stored in the form of chip at the level of the anti-theft device based the technology already used in IC cards.

The invention shall now be described by way of preferred embodiments, given purely as non-limiting examples, with reference to the appended drawings in which:

- figure 1 is a longitudinal sectional view of the anti-theft device according to a first embodiment of the invention;
- ~~figure 2 is a cross-sectional view along the line II-II' of figure 1;~~
- figure 3 is a cross-sectional view along the line III-III' of figure 1;
- figure 4 is a simplified side view of the embodiment of figure 1 mounted in a locking position on a brake disk;
- figure 5 is a longitudinal sectional view of a handlebar adaptor for mounting the anti-theft device of figure 1 onto a handlebar to form an end-piece;
- figure 6 is a partial longitudinal sectional view of the anti-theft device according to a second embodiment of the invention;
- figure 7 is a front view of a threaded ring of the anti-theft device for coupling onto a handlebar adaptor according to the second embodiment of the invention;
- figure 8a is a partial longitudinal sectional view of the anti-theft device according to a variant of the second embodiment;
- figure 8b is a cross-sectional view along line IIX-IIX' of figure 8a;
- figure 9a is a partial longitudinal sectional view of the anti-theft device according to a third embodiment of the invention;
- figure 9b is a partial longitudinal cross-sectional view of an adaptor for mounting the anti-theft device of figure 9a onto a handlebar to form an end-piece;

- figure 9c is a front view of the adaptor shown in figure 9b;
- figure 10a is a simplified view of the front face (seen from the handlebar or brake disk) of the anti-theft device according to a fourth embodiment of the invention;
- figure 10b is a partial and simplified cross-sectional view of an adaptor for mounting the anti-theft device of figure 10a;
- figure 11a is a partial longitudinal sectional view of the anti-theft device according to a fifth embodiment of the invention;
- figure 11b is a partial cross-sectional view of an adaptor for mounting the anti-theft device of figure 11a onto a handlebar to form an end-piece;
- figure 11c is a front view of the adaptor shown in figure 11b;
- figure 12 is a side view of a pin portion of an anti-theft device incorporated into a second end piece according to variant embodiment;
- figure 13 is a schematic diagram of a the anti-theft device of the first embodiment and its adaptor, adapted to cooperate with an alarm/anti-ignition system according to a first example; and
- figure 14 is a schematic diagram of the anti-theft device of the first embodiment and its adaptor, adapted to cooperate with an alarm/anti-ignition system according to a second example.

Referring to figure 1, the anti-theft device according to the first embodiment comprises a main body portion 2 which forms the essential part of a handlebar end-piece and a detachable pin element 4 adapted to be received in a locking relation with the main body portion. The main body portion 2 has the shape of a solid of revolution. It is defined by a front face 2a (seen from brake disk or the handlebar) having a relatively large diameter, a rear face 2b having a smaller diameter and a sidewall 2c which follows a continuous curved profile between the front and rear faces 2a and 2b. The front face 2a is substantially flat or at least configured to rest flush against a flat surface when pressed against the latter.

The main body portion 2 comprises a central cylindrical cavity 6 adapted to receive the pin element 4 with a snug fit and a key-rotatable lock mechanism 8a, 8b mechanically connected to a pair of catch elements 10. The wall of the cavity 6 is lined with a nylon or rubber sleeve 12 adapted to grip slightly the pin element 4 so that it cannot fall loose when unlocked from the main body portion.

The lock is of classical design based on a cylindrical stator 8a and a rotatable barrel 8b housed within the stator and accessible by a keyhole 9 at the rear face 2b. An example of such a lock mechanism can be found e.g. in French patent application FR-A-2 343 107.

The inner wall of the cavity 6 has a pair of diametrically opposed openings 14 each housing a respective catch element 10. The catch elements are biased by a spring 16 to project inside the cavity 6. The part of the catch element 10 that projects inside the cavity 6 has a bevelled edge 10a on the face turned towards the opening 6a of the pin-receiving cavity.

As shown in figure 2, each opening 14 has an axially-extending slot 18 at its portion remotest from the opening 6a of the pin-receiving cavity. The slot 18 receives a finger element

20 having one end 20a fastened onto the non-projecting end of the catch element 10. The other end 20b of the finger element is in sliding contact with the peripheral edge of an ellipsoidal wheel 22 which forms a cam drive.

As shown more clearly in figure 3, the ellipsoidal wheel 22 is centrally attached to a shaft 24 which is rotatable coaxially with the lock barrel 8b. The ellipsoidal wheel 22 is biased by a traction spring 26 to settle at a rotary position where the pair of finger elements 20 rests at points of the peripheral edge which are aligned with the smallest diameter D1 of the ellipse. At this position, the catch elements 10 project into the pin-receiving cavity 6.

Referring back to figure 1, an externally threaded ring 28 projects concentrically from the front face 2a of main body portion. The ring 28 is fully retractable within an annular channel 30 formed on the front face 2a. The inner end of the ring 28 has a peripheral flange 28a which is received in the channel 30. A flat annular retaining ring 32 is provided concentrically on the outer part of the front face 2a. The inner edge of the ring 32 partially projects over the entrance to the annular channel 30 and confronts the shoulder portion of the flange 28a, thereby retaining the latter in its channel.

It can be noted that the ring 32 is sufficiently thin for its outer surface to be considered as being to all intents and purposes in the plane of the front face 2a. The same technical effect can also be achieved by replacing the retaining ring 32 with a rib or the like within the annular channel 30 and near its opening so as to form an abutment for the flange 28a.

A spring 34 is contained within the annular channel 30, between the base of the latter and the rear face of the flange 28a. The spring 34 applies a weak force against the flange 28a, just sufficient to cause the ring 28 to project against the retaining ring 32 in the rest state.

A set of inwardly-projecting lugs 36 is provided at the inner wall of the threaded ring 28. ~~Each lug 36 is received in a corresponding groove 38 which extend longitudinally along~~ the inner wall portion of the annular channel 30. The groove and lug arrangement allows the threaded ring 28 to be driven into rotation by turning the main body portion 2.

The detachable pin element 4 comprises a straight stem 40 terminated at a first end by a rounded tip portion 42 and at a second end by a head 44. The head has a flat inner face 44a and a rounded outer face 44b. The cross-section of the stem 40 is typically of 4 to 8 mm to allow a clear passage through a disk brake perforation without leaving too large a peripheral gap. The diameter of the head 44 is substantially greater than that of a disk brake perforation, for example 10 mm or more.

A shroud 46 having a diameter substantially equal to that of the head is affixed at one end to the inner face 44a of the head. The shroud 46 is resilient in the axial direction of the shaft 40 so that it can be compressed against the inner face 44a of the head when pressure is applied against its free end 46a. In the example, the shroud 46 comprises a short sleeve of spring steel having accordion-like corrugations to confer the required resilience.

A circumferential groove 48 is provided around the stem 40 near the first end 42. The position and depth of the groove 48 is adapted to allow the catch elements 10 to be received

therein when the pin 4 is fully inserted into the cavity 6 of the main body portion 2 and the lock is activated.

When the locking pin 4 is mated with the main portion 2, the first end 42 is inserted through the sleeve 12 in the cavity 6. As the tip comes into contact with the projecting catch elements 10, the latter are pushed towards the retracted position by the outward thrust generated owing to the bevelled face 10a, and kept retracted by the leading part 42a of the stem up to the circumferential groove 48. As soon as the circumferential groove 48 becomes aligned with the catch elements 10, the latter penetrate therein under the action of their respective springs 16 and thereby prevent the withdrawal of the pin 4.

The pin 4 is releasable by turning the lock barrel 8b with a key through a quarter turn so that the ellipsoidal wheel 22 rotates against its bias spring 26 to causes the finger elements 20 to rest at points on the outer surface of the wheel that are aligned with its largest diameter D2 (figure 3), thereby causing the catch elements 10 to retract into their respective slots 18 against the springs 16.

An alternative to the above-described pin locking mechanism can be found in French patent document FR-A-2 597 144 whose contents are hereby incorporated by reference. According to this document, the locking pin – which also has an annular groove - is held captive in the lock body by a pair of aperture elements mounted on eccentric guide surfaces which rotate with the lock so as move towards each other into the groove of the pin or away from each other in the transition to the locked and unlocked states respectively. As in the present embodiment, the lock barrel and pin are coaxial.

The lock arrangement can also be implemented with the lock barrel disposed perpendicular to the axis of the pin, as taught in patent document EP-A-0 208 813, for example, whose contents are also incorporated herein by reference. In this case, the lock mechanism causes a catch to project along the axis of the lock barrel and penetrate inside the annular groove of the locking pin.

It can be noted that all the above-described lock arrangements do not prevent axial rotation between the main body and the locking pin. In this way, the lock cannot be forced by attempts to rotate the main body portion 2.

Figure 4 illustrates schematically the anti-theft device 2,4 mounted on a brake disk 50 so as to immobilise the associated vehicle. The locking pin 4 is inserted through a perforation 52 of the brake disk, e.g. from the inboard side 50a. The projecting part of the stem 40 is then made to engage into cavity 6 of the main body portion 2 by bringing the latter in alignment against the outboard side 50b of the brake disk. During this action, the first contact of the main body portion 2 with the brake disk 50 is at the level of the threaded ring 28, which retracts into its annular receiving channel 30 as the main body portion is further pushed towards the brake disk. When the threaded ring 28 is fully retracted into its receiving channel 30, the front face 2a of the main body portion makes contact with the brake disk 50. At that stage, the locking pin 4 is on the verge of locking into place; further travel of the stem 40 inside the cavity 6 for achieving the locking position is obtained by compressing the resilient shroud 46 against the

inboard face 50a of the brake disk. When the locking pin 4 snaps into the locking position, the anti-theft device is maintained securely on the brake disk, with the front face 2a of the main body portion pressed flush against the outboard side 50b due to the expansion force exerted by the resilient shroud 46.

The shroud 46 is an example of resilient means acting to bring each part of the anti-theft device on either side of the brake disk in pressing contact with the latter and thereby eliminate any possible free gap between the anti-theft device and the brake disk. A similar resilient shroud could also be provided on the front face 2a of the main body portion instead of or in addition to the one on the locking pin.

It can be noted that the compressive travel of the spring shroud 46 makes it possible to accommodate for different brake disk thicknesses whilst ensuring that the flat front face 2a of the main body portion 2 is always kept flush with the brake disk. The device according to the invention therefore leaves no room for applying a forcing tool between itself and the brake disk. As the variations in brake disk thicknesses amount to a few millimetres at the most, the spring shroud only needs to provide a correspondingly short amount of compressive travel. Accordingly, even in the case of a thin brake disk, a pull exerted on the main body portion 2 can only yield a small gap between the flat face and the disk surface, and the pulling force would have to be applied continuously to keep that gap exposed.

A similar technical effect can be achieved by mounting the catch elements 10 on an axially displaceable rack. During the locking operation, the rack is displaced away from the front face 2a by a spring mechanism or by pulling on the lock 8a, 8b so that the front face 2a and the locking pin 4 press against the respective sides of the brake disk 52. The rack can be immobilised at its displaced position once the lock is activated. A series of closely spaced immobilising positions can be provided along the displacement path of the rack to allow for different brake disk thicknesses, e.g. using classical ratchet mechanisms. Lock mechanisms which are axially displaceable are in themselves known in the art.

It will be appreciated that the curved and tapered profile of the sidewall 2c is difficult to grip tightly with a forcing tool, such as a wrench. The sloping sidewall 2c also precludes the possibility of applying a levering force on the main body portion by inserting a tube over the latter.

The spring shroud 46 also acts as a damper for absorbing energy from impacts such as hammer blows applied against the side of the main body portion 2 or the locking pin 4.

Figure 5 is a cross-sectional view of a mounting adaptor 60 which is insertable inside a handlebar 62 for supporting the anti-theft device of the first embodiment so as to allow it to function as a handlebar end-piece.

The adaptor 60 comprises a short cylindrical sleeve 64 closed at one end by a base 66 and configured to fit substantially without play inside a handlebar 52. The depth of the sleeve 64 is sufficient to accommodate the portion of the anti-theft device which projects from its front face, i.e. the head 44 of the locking pin when the latter is stowed by being locked in the anti-theft device. The internal surface of the sleeve at the open end 64a is dimensioned and

threaded 66 so as to engage with the threaded ring 28 of the main body portion. A peripheral lip 68 made of resilient material, such as an elastomer, projects radially from the open end of the sleeve 64 to cover the edge of the handlebar 62.

The sleeve 64 is associated with a gripping device comprising a toroidal expansion ring 70, made e.g. of spring steel coated with high friction material such as rubber, and a thrust plate 72. The ring 70 is sandwiched between the thrust plate 72 and the outer face of the base 66 of the sleeve, and is held in place by clasps 74. A round-headed bolt 76 passes centrally through the base 66, the expansion ring 70 and the thrust plate 72, with its head 76a accessible from inside the sleeve 64. A nut 78 is held locked on the outer face of the thrust plate 72 by means of projecting ridges 80 and is threadedly engaged with the bolt. The end faces of the expansion ring 70 can thus be controllably compressed between the base 66 and the thrust plate 72 by tightening the bolt. In its uncompressed state, the expansion ring 70 has an overall diameter just smaller than the internal cross-section of the handlebar 52. As the expansion ring is compressed, it deforms and bulges out to assume a greater overall diameter.

For installation, the bolt 76 is initially untightened to allow the expansion ring 70 to assume the uncompressed state. The adaptor 60 is inserted inside the handlebar 52 so that the open end 64a of the sleeve is substantially flush with the end of the handlebar and the peripheral lip 68 covers the open edge the latter. The head of the bolt 76 is then accessed by a screwdriver to compress the expansion ring 70. The tightening force causes the ring to expand against the internal surface of the handlebar and thereby grip the adaptor 60 firmly in place.

The anti-theft device 2,4 fits on the adaptor 60 by engaging its threaded ring 28 with the internal thread 66 of the sleeve 64. Once fully tightened, the anti-theft device is pressed against the peripheral lip 68 and a hermetic connection is thereby established. It can also be noted that the lip provides vibration damping for the screw mounting and thereby helps prevent the end-piece from becoming loose.

The above-described screw mount can of course be replaced by other known equivalent means such as friction mounts and bayonet mounts.

In a second embodiment of the invention which shall now be described with reference to figure 6, the anti-theft device is lockable onto the handlebar using the same lock barrel as for securing the locking pin. The general configuration of the second embodiment is analogous to that of the first embodiment, notably as concerns the mechanism for securing the locking pin in the cavity of the main body portion 2 and the general shape of the latter. Accordingly, only the essential differences with regard to the first embodiment shall be described and like parts are given the same figure references.

Figure 6 is a simplified view of the main body of the anti-theft device along the same cross-section as in figure 1, showing in detail the part of the main body portion 2 at the level of the threaded ring 28 and its annular channel 30. As in the first embodiment, the threaded ring 28 has a peripheral flange 28a which is held captive in the annular channel 30 by a retaining ring 32. The flange 28a is likewise kept pressed against the retaining ring 32 by a weak spring 34. However, by contrast with the first embodiment, there is no set of inwardly projecting lugs

36 and corresponding receiving channels 38 (cf. figure 1) that permanently couple the threaded ring 28 in rotation with the main body portion 2. Therefore, the threaded ring is rotatable with respect to main body portion 2 simply by overcoming the frictional forces at the contacting surfaces, notably at the level of the flange 28a.

As shown in figure 7, the flange 28a has two narrow circumferential cutouts 80, each occupying just less than half the circumference of the flange. The cutouts 80 are configured to be centred between the inner and outer walls of the annular channel 30.

The base of the channel 30 has two diametrically opposed bores 82 which each constitute a guide channel for a respective shaft 84 received therein. Each shaft 84 has a proximal end 84a projecting from the inner end 82a of the bore and a distal end 84b directed towards the annular channel 30. The proximal end 84a of the shaft has a peripheral flange 86. A compression spring 88 is fitted around the shaft 84 and retained between the peripheral flange 86 and the inner end 82a of the bore 82.

Each shaft 84 is axially slidable along its bore 82 over a predetermined extent by means of a pushrod 90 acting on the tip at the proximal end 84a. Each pushrod 90 is perpendicular to its shaft 84 and has a base 90a connected to a respective finger element 20 that rides on the peripheral edge of the ellipsoidal wheel 22. The free end of the pushrod 90 has a cam head 92 presenting a grooved track 94 for slidably receiving and guiding the proximal end 84a of the shaft. The track 94 follows a curve with respect to the principal axis of the shaft 84 such that an axial displacement of the pushrod causes a perpendicular displacement of the shaft along its axis. The force of the compression spring 88 ensures that the peoximal end 84a of the shaft is always kept pressed in contact against the grooved track 94.

When the lock is activated for locking the pin 4 and the finger elements 20 are aligned with the smallest diameter D1 of the ellipsoidal wheel 22 (cf. figure 3), the cam head 92 is at its most retracted position (shown in normal lines in 6 figure) and the proximal end 84a of the shaft contacts the grooved track at a position P1. At that position, the shaft 84 has a minimum projection at the level of the annular channel 30, its tip at the distal end 84b terminating at a inside the channel 30 at a point M1 near the base.

When the lock is released and the finger elements 20 are aligned with the largest diameter D2 of the ellipsoidal wheel 22, the cam head 92 is at its most projected position and the proximal end 84a of the shaft contacts the grooved track 94 at a position P2 (dotted lines). At that position, the shaft 84 has a maximum projection, its tip at the distal end 84b terminating at a point M2 just short of the opening of the annular channel 30. At that position, the distal end 84b of each shaft is engaged in a respective circumferential cutout 80 of the flange 28a.

When the anti-theft device is in the unlocked state, whereby the tip of the shaft at the distal end 84a is at point M2, the threaded ring 28 is mechanically coupled for rotation with the main body portion 2 once an end point 80a or 80b (figure 7) of each of the circumferential cutouts 80 comes into abutment against the distal end of a respective shaft 84. This coupling is effective for both directions of rotation, each direction causing a respective end point 80a or 80b of the circumferential cutout 80 to abut against the end of the shaft 84. In this way, the

anti-theft device can be mounted on and removed from the handlebar adaptor 60 as in the first embodiment simply by turning the main body portion 2.

When the anti-theft device is in the locked state and the tip of the shaft at the distal end 84b is thus retracted to point M1, the threaded ring 28 is no longer mechanically coupled for rotation with the main body portion 2. It is thus impossible to dismount the anti-theft device from the handlebar by turning the main body portion. It can be noted that the distal end 84b of the shaft is sufficiently retracted at point M1 so as not to project into a circumferential cutout 80 even when the threaded ring 28 is itself fully retracted inside the annular channel 30 (dotted lines), as when the anti-theft device is locked onto a brake disk 50. Accordingly, the threaded ring 28 is at all times uncoupled from the lock mechanism when the anti-theft device is in a locked state, thereby conferring additional protection.

Figures 8a and 8b show a variant of the second embodiment which provides the same technical effect. The inner wall of the threaded ring 28 is provided with a series of axial grooves 91 which extend throughout its length. A pair of diametrically opposed studs 93 is received in respective bores 95 which open inside the annular channel 30 near the front face 2a of the main body portion. Each stud 93 is displaceable to project from its respective bore 95 or to retract completely within the latter by means of a linkage 96. The linkage couples the base 93a of the stud to a respective finger element 20 of the lock mechanism. The studs are displaced via a compression spring 98 interposed between the base 93a of the stud and the linkage 96.

In the variant, the above stud and linkage arrangement replaces the shaft and pushrod mechanism of the second embodiment, but all other aspects of the anti-theft device are otherwise identical.

When the lock mechanism is set in the unlocked state, the finger elements 20 are displaced radially outwards and the linkage 96 is consequently shifted in the direction of arrow S3 at the base of the spring 98, tending to compress the latter. The studs 93 are thereby caused to press against the inner wall of the threaded ring 28 under the force of the spring 98. If the studs 94 confront a portion of the ring between two axial grooves 90, the springs 98 remain compressed by their respective linkages 96 until they are made to confront respective grooves 90 by rotation of the main body portion 2. The studs 93 are then allowed to project inside the grooves 90 under the force of the springs 98. Thereafter, the threaded ring 28 is mechanically coupled for rotation with the main body portion 2 by abutment of the studs 93 against the sidewalls of the axial grooves 90. The anti-theft device can then be screwed or unscrewed from its handlebar adaptor 60 or handlebar by turning the main body portion 2.

When the lock mechanism is set in the locked state, the finger elements 20 are shifted in the direction S4 and the springs 98 are pulled by their respective linkages 90. Traction is transmitted from the springs to the studs 93, causing the latter to retract completely from their respective axial grooves 91. The threaded ring 28 is thereby mechanically uncoupled from rotation from the main body portion 2 and thus cannot be screwed or unscrewed from the handlebar adaptor 60 by turning the main body portion 2.

As in the second embodiment, the selective coupling or uncoupling in rotation of the threaded ring 28 is effective irrespective of whether the latter is fully retracted in its annular channel 30 or projecting from the front face 2a of the main body portion 2. In particular, the studs 93 can slide freely along their axial grooves 91 as the threaded ring moves axially within its annular channel.

The second embodiment and its variant allow a configuration in which the anti-theft device is lockable onto a handlebar to form an end-piece, with the following two characteristics, both of which are optional aspects of the invention: i) the outer diameter of the main body portion 2 at the front face 2a coincides substantially with that of the handlebar, ii) no part projecting from the end of the handlebar is necessary to hold the anti-theft device in position and iii) the front face 2a is substantially coplanar with the peripheral edge of the sidewall 2c of the main body portion 2 at the front end 2c' (cf. figure 1).

This last characteristic implies that there is no inward step or radial recess formed between the front face 2a and the front edge of the sidewall, making the device particularly secure.

There shall now be described with reference to figures 9a, 9b and 9c a third embodiment of the invention which does not possess this characteristic, but to the benefit of a mechanically simpler design.

As shown in figure 9a, the main body portion 2 of the anti-theft device according to the third embodiment differs from that of the second embodiment essentially at the region of the front end and the linkage 96. The lock mechanism, locking pin and general configuration are essentially unchanged and shall not be described again for conciseness.

The main body portion 2 presents a stepped profile 100 between the front edge 2c' of its sidewall 2c, where the diameter is relatively large, and the front face 2a, where the diameter is smaller. The step 100 is formed by a shoulder 102 at the front edge 2c', presenting a flat annular face turned towards the front end, and a cylindrical section 104 which projects beyond the shoulder 102 and has the smaller diameter.

The projecting cylindrical section 104 has two diametrically opposed axial bores 94 which receive respective studs 93 in sliding engagement, as in the second embodiment. Each stud 93 is axially displaceable by the lock mechanism between a retracted position where its tip is flush or sunken with respect to the outer surface of the cylindrical section 94 and a projected position where the stud protrudes from the latter. The axial displacement of the studs 93 is effected by a respective finger element 20 that activates the lock, as previously described with reference to figure 1. Each finger element 20 is connected to one end of a linkage 96 composed of three articulated members 96a, 96b and 96b joined end to end. The other end of the linkage 96 is connected to a respective stud 93 via a spring 98 in the same manner for the stud-and-spring connection described with reference to figures 8a and 8b. The central member 96b of the linkage is pivotally mounted about an axle 106 so as to invert the displacement directions at opposite ends the linkage.

When the anti-theft device is set to the locked state and the finger elements 20 of the lock are consequently shifted in the direction of the arrow S5, each linkage 96 causes a stud 93 to move axially in the direction of the arrow S6 and thereby protrude from the projecting cylindrical portion 104.

Conversely, when the anti-theft device is set to the unlocked state, the displacement of the finger elements 20 causes the studs 93 to retract from the projecting cylindrical portion 104.

As shown in figures 9b and 9c, the adaptor 60 for lockably receiving the anti-theft device of the third embodiment differs from that of figure 5 at the level of the opening of the sleeve 64, but is otherwise identical, notably in respect of its method of mounting inside the handlebar. The inside surface of the sleeve 64 near the opening is provided with a series of radially disposed blind bores 108, each adapted to receive and retain a stud element 92 of the anti-theft device when the latter is mounted on the handlebar to form an end-piece.

The end of the sleeve 64 forms a peripheral lip 68 which covers the edge of the handlebar. The lip 68 is either made of an elastomer material or configured as a spring so as to be axially compressible. The relative dimensions between the corresponding elements are such that the lip 68 needs to be compressed by the annular shoulder 102 of the main body portion 2 before the studs 93 can be axially aligned with the blind bores 108.

The main body portion 2 locks onto the sleeve 64 by insertion of the projecting cylindrical portion 104 into the sleeve opening until the lip 68 is compressed. The lock is then set to the locked state so that the springs 98 urge the studs 93 to protrude. If the studs are not aligned with the blind bores 108, the springs 98 become compressed and the studs press against the sleeve 64 at regions 110 between the bores. Rotation of the main body portion 2 while keeping the lip 68 compressed will then bring the studs into alignment with a pair of diametrically opposite bores, allowing the studs to project inside the latter and be retained therein.

Once the anti-theft device is thus locked onto the handlebar, the expansion force exerted by the resilient lip 68 ensures a tight, vibration-proof fit by keeping the studs 93 firmly in abutment against the sidewall of the bores. The same technical effect can of course be achieved by providing an axially resilient device on the shoulder 102 of the main body portion 2.

In the example, the inner surface of the sleeve 64 is profiled at the region of its opening 112. This allows the main body portion 2 to be inserted into the sleeve 64 even when in the locked state. In such a case, the projecting studs 93 are gradually forced against their springs 98 into their retracted position by the curved surface 112 until they can project into the blind bores 108, thus allowing the main body portion 2 to be click fitted onto the handlebar.

The shoulder 102 can be set relatively close to the front face 2a of the main body portion and need only have a depth corresponding to the combined thickness of the material forming the handlebar tube and sleeve 64. Consequently, the anti-theft device according to the third embodiment offers very little possibility for applying a forcing tool between the shoulder and the brake disk, for example.

There shall now be described with reference to figures 10a and 10b a fourth embodiment of the invention in which the front face 2a of the main body portion 2 is substantially coplanar with the front edge 2c' of the sidewall, as in the first and second embodiments, but for which the handlebar adaptor 60 projects slightly from the end of the handlebar. Its basic structure is the same as in the first embodiment and only the contrasting features shall be described for conciseness.

The front face 2a of the main body portion is substantially flat and has a diameter adapted to that of the handlebar. An annular threaded groove 120 is provided concentrically on the front face for connection to the handlebar adaptor 60.

The sleeve 64 of the handlebar adaptor 60 has an end portion 122 which projects a small distance from the end of the handlebar and is provided with an external thread 124 for engagement with the annular threaded groove 120. An axially compressible lip or washer 126 is provided on the sleeve 64 so as to cover the edge of the handlebar 62.

The main body portion 2 can thus be screwed into position on the handlebar to form an end-piece and be maintained securely against vibrations by the lip or washer 126. When the anti-theft device is in place on the handlebar, the front face 2a of the main body portion 2 is flush against the end of the handlebar, as in the other embodiments.

There shall now be described with reference to figures 11a, 11b and 11c a fifth embodiment which differs from the fourth embodiment essentially in that the anti-theft device can be locked onto the handlebar. Only the contrasting features shall be described for conciseness.

The front face 2a of the main body portion 2 has an annular groove 120 corresponding to that of figure 10, but in which the thread is replaced with the lock-displaceable stud mechanism as described in connection with the variant of the third embodiment.

An axially compressible washer 130 is provided at the base of the annular groove 120. A pair of diametrically opposed studs 93 are arranged to protrude from respective radial openings 94 at the innermost sidewall of the annular groove when the lock is set to the locked state. As can be seen from figure 10, the lock-displaceable stud and spring mechanism 94-98 is identical to that of the third embodiment and shall not be described again for conciseness.

The sleeve 64 of the adaptor 60 has a portion 122 which projects a small distance from the end of the handlebar for engagement in the annular groove 120. The projecting portion is provided with a series of blind bores 91, analogous to those shown in figures 9b and 9c, adapted to receive and retain the pair of studs 93 of the main body portion 2 when the latter is inserted into the adaptor 60.

The anti-theft device is thus mountable onto the adaptor 60 as in the third embodiment as far as the locking engagement of the studs into the blind bores is concerned. The leading edge of the sleeve 64 is given a curved contour 112 analogous to the curved surface of the third embodiment to cause the studs 93 to contract against their respective springs 98 upon insertion into the adaptor 60, thereby also allowing a click fit.

The washer 130 is compressed when the anti-theft device is mounted, thereby ensuring a secure, vibration-proof fit. In the example, a similar washer 134 is also provided for similar effect on the outer periphery of the front face 2a of the main body portion 2.

It is clear that all the embodiments described can also be implemented without using a handlebar adaptor, by forming the means for holding the anti-theft device as an integral part of the handlebar itself. Depending on the embodiments and variants considered, this can be achieved providing the end of the handlebar with either of: a thread tapped on the inner or outer surface, perforations for receiving the aforementioned studs of the anti-theft device, a bayonet socket, etc. In the embodiments where the handlebar adaptor projects from the handlebar, similar means can be provided on the handlebar at a portion which projects beyond the outer end of the handgrip. Any perforation or cutouts on the handlebar will normally be covered by the handgrips and thus be protected from the elements.

In all the embodiments, a sealing cap or sleeve can be provided for closing the open end of the handlebar when the end-piece is removed.

As a variant applicable to all of the above-descibed embodiments, the locking pin 4 can be formed integral with a second end piece for the handlebar. In other words, the anti theft device in this case comprises a first end piece 2 containing a lock mechanism 8-20 and pin receiving cavity 6 substantially as described with reference to figures 1-11, and a second end piece which incorporates the pin portion 4 previously described. In this case, the head portion 44 is configured to form a second end piece (designated 200).

An example of this variant adapted to the first embodiment is shown in figure 13 and is generally designated by reference numeral 4'. Here, the mechanism 2c', 28-36 for attachment of the second end piece to the handlebar is to all intents and purposes identical to the one for attaching the first end piece 2 and shall not be described again for conciseness. The main body portion 200 has a shape identical to body portion 2 forming the visible part of the end piece. The spring system 46 is provided at an inner face 44a, analogously to the attachment pin 4 previously described. The pin portion 40 is also identical to the one shown in figure 1.

It is clear that the same concept of making the attachment pin 4 integral with a second end piece can be adapted to all the other embodiments. The second end piece 200 can also be made lockable onto the handlebar, if required, using a system similar to that described e.g. with reference to figures 6-11, except for the aspects specific to the locking cavity and catches.

The second end piece 200 can be stowed at an end of the handlebar in substantially the same manner as described for the first end piece.

The above variant thus utilises two separate end pieces 2 and 200, one for containing the pin-securing lock mechanism, the other containing the pin.

Such a two-end-piece embodiment can be adavantageous from the point of view ease of use – the pin portion is connected to a larger size item which is easier to handle. Besides, such a construction can be made more balanced and solid, depending on design.

The parts forming anti-theft device described with reference to figures 1-11 can be made from standard materials : hardened steel or other hard metal allow for the pin portion 40,

catches 10 and other stressed parts (in a burglary attempt), brass or similar material for the lock mechanism (barrel, etc). The body portions 2 and/or 200 can be made of steel or lighter alloy to optimise weight.

Naturally, high technology components can also be envisaged where appropriate, such as carbon fiber resins, ceramics, etc.

There shall now be described with reference to figure 13 a second aspect of the present invention in which the anti-theft device is furthermore operative to control an alarm and/or anti-ignition system associated with the vehicle. This aspect ensures that the system cannot be deactivated all the while the anti-theft device is not stowed in its position where it serves as a handlebar end-piece. It can be noted that the second aspect of the invention can be implemented in any of the embodiments and its variants previously described.

In figure 13, the adaptor 60 - which in the example corresponds to the one described with reference to figure 5 – is fitted with two electrical contact elements 140 which project inwardly from diametrically opposed points of the sleeve 64 so as to press against the locking pin 4 when the anti-theft device is installed. The contact points of the locking pin (at the level of the head 44 in the example) establish a conductive path between the two contacts 140.

Each contact 140 is connected to respective electrical conductors 142a, 142b which run along the adaptor and are lead out of the handlebar, e.g. at a point near the inner end of the handgrip to connect with an alarm/anti-ignition system of the vehicle.

The alarm/anti-ignition system is provided with a continuity test module 146 which determines whether or not there is electrical continuity between the contact elements 140 and with an alarm/ignition controller 148 which keeps the system active all the while there is no continuity detected between the two contacts 140. Thus, the presence of the locking pin 4 ~~bridging the two contacts 140 causes the alarm/anti-ignition system to be disabled (so long as any other possible conditions monitored by the system are also satisfied). The continuity test~~ module 146 and alarm/ignition controller 148 may be part of the alarm/ignition system *per se* or provided as an interface unit.

In this way, not only is there provided a further safeguard against theft of the vehicle, but the user is also warned or prevented from using the vehicle without the anti-theft device removed from the brake disk and properly installed on the handlebar. Moreover, by arranging for the electrical connection to be established through the locking pin 4, the user can know for sure whether the latter has been put back in the main body portion 2 when stowing the device on the handlebar.

There shall now be described with reference to figure 14 another example of an anti-theft device according to the present invention equipped to cooperate with an alarm/anti-ignition system.

The sleeve 64 of the adaptor 60 is provided with first to fourth separate electrical contacts 150a-150d on its inside surface near the opening, each electrically connected to respective circuit elements of an alarm/anti-ignition system of the vehicle or an interface unit for the latter, as shall be described in more detail below.

The main body portion 2 of the anti-theft device is likewise provided with corresponding first to fourth electrical contacts 152a-152d each adapted to connect electrically with a corresponding respective contact 150a-150d of the sleeve 64. A pair of matable indexing elements 154a, 154b is provided on the sleeve 64 and the main body portion 2 respectively to ensure proper electrical interconnection between the contacts.

The main body portion 2 contains a microelectronic circuit centred around a read-only memory (ROM) 156 containing coded data, a serial-to-parallel converter 158 and a parallel-to-serial converter 160. The microelectronic circuitry is powered from voltage lines V_{DD} and V_{SS} from a power supply 151 of the alarm/anti-ignition system via contacts 152a and 152b respectively.

The serial-to-parallel converter 158 has a data input D_{IN} connected to the third electrical contact 152c and parallel data output lines connected to the address inputs A_0-A_3 of the ROM 156. The parallel-to-serial converter 160 has its parallel data inputs connected to the data outputs D_0-D_3 of the ROM 156 and its serial data output D_{OUT} connected to the fourth contact 152d.

The alarm/anti-ignition system is provided with a data interfacing circuit comprising voltage output VDD and VSS lines connected to the first and second contacts 150 a and 150b of the sleeve 64 and interrogation circuitry for detecting and analysing the coded data stored in the ROM 156 of the main body portion 2.

The interrogation circuitry comprises a ROM 162 which stores the same data as in the ROM 156 in the main body portion 2 at corresponding addresses. An address generator 164 issues a predetermined address to the respective address inputs A_0-A_3 of ROMs 156 and 162. The address is received by the ROM 162 in the interfacing circuit in parallel form directly from a data bus 166 and by the ROM 156 in the main body portion 2 successively via: a parallel-to-serial converter 168 from which it is transmitted in serial form over a single conductor 170 to the third contact 150c of the sleeve and over to the input to the serial-to-parallel converter 158 of the main body portion, where it is restored to the original parallel form and supplied fed to the address inputs A_0-A_3.

In response, the ROM 162 in the interfacing circuit delivers the data D_0-D_3 corresponding to the address to a first, four-bit comparison input C1 of a data comparator 172. The ROM 156 in the main body portion 2 delivers the corresponding data D_0-D_3 to the parallel-to-serial data which sends it in serial form across the fourth contacts 152d and 150d and over a single conductor 174 in the interfacing circuit to a serial-to-parallel converter 176 therein. The data D_0'-D_3' from the ROM 156 is relayed in parallel form from the converter 176 to a second, four-bit comparison input of the data comparator 172 via a bus 178.

The data comparator delivers a signal S_{DIS} operative to disable the alarm/anti-ignition only if the data D_0'-D_3' from the ROM 156 in the main body portion 2 matches the data D_0-D_3 from the ROM 162 in the interfacing circuit.

In this way, it is possible to individualise each anti-theft device with its code established in correspondence with a code of the alarm/anti-ignition system.

The address generator 164 can be set to generate random addresses or a specific address.

It will be apparent from the above description of the preferred embodiments that the present invention can take on many different forms without departing from the scope of the appended claims. The skilled person will notably be aware that many well-known or obvious variants can be adopted for implementing lock mechanism, both for retaining the locking pin and locking the device onto a handlebar.

It is also possible to accommodate for different brake disk thicknesses by providing a choice of adapted locking pins, each giving a set gap between the male and female coupling members for enclosing the brake disk when in the locked state.

Alternatively, the pin can be configured to make the aforementioned gap correspond to the thickest possible brake disk to be accommodated and one or both of the male and female coupling members (locking pin or main body portion) can be adapted to receive one or several packing elements that reduce the gap to correspond to a thinner brake disk.

It is also envisageable to provide means for closing off the end of handlebar when the anti-theft device is removed from the latter to prevent the ingress of rain or dirt. These can include a separate cover element which can be of rigid, semi-rigid or soft material. In the latter case, the cover can be in the form of glove with an elasticated opening which fits over the hand-grip. The handlebar adaptor can be adapted to house the cover when the anti-theft device is mounted to function as an end-piece.

CLAIMS

1. An anti-theft device (2, 4; 4') for a vehicle equipped with handlebar means (62) and at least one brake disk (50) presenting perforations (52) therein or openings at the disk support structure, the device comprising locking means for locking onto a brake disk via a said perforation or opening and characterised in that it further comprises coupling means (28; 92) for fastening onto at least one end of said handlebar means (62) so as to function as at least one end-piece for the latter.

2. The anti-theft device (2, 4;4') according to claim 1, composed of first and second separable parts (resp. 2, 4) which are lockable with respect to each other through a perforation (52) or opening of the brake disk (50).

3. The anti-theft device (2, 4;4') according to claim 2, wherein said first and second separable parts are respectively comprised of female (2) and male (4) mating members, the male mating member comprising an element (40) adapted to pass through the perforation (52) or opening of the brake disk (50) and the female mating member comprising a lock mechanism (8a, 8b, 10, 14-22) arranged to secure the male mating member in engagement therewith when in the locked state.

4. The antitheft device (2, 4') according to claim 3, wherein the female mating member (2) and the male mating member (4') are respecively incorporated in a first endpiece (2) and in a second end piece (200) (figure 12).

5. The anti-theft device (2, 4;4') according to any one claims 2 to 4, wherein said male mating member (4) is in the form of a pin terminated by a head (44) at its distal end and is provided with a notch or peripheral groove (48) at its proximal end, and wherein said female mating member is in the form of a main body portion (2) containing a recess (6) for receiving said pin (4) and a lock mechanism (8a, 8b) cooperating with catch means (10) within said recess for lockably engaging with said notch or peripheral groove when in a locked state.

6. The anti-theft device (2, 4;4') according to any one of claims 2 to 5, wherein the respective faces (46a, 2a) of the male and female mating members (4, 2) that confront the brake disk (50) are configured to be flush against the respective sides (50a, 50b) of the latter.

7. The anti-theft device (2, 4;4') according to any one of claims 1 to 6, further comprising resilient means (46, 134) to impart pressing contact against the sides (50a, 50b) of the brake disk (50) when in the locked state, so that there is substantially no visible gap between the brake disk and the anti-theft.

8. The anti-theft device (2, 4;4') according to claim 7, wherein said resilient means (46) are in the form of a spring element having resilience along its principal axis, such as a coil spring or a profiled ring formed of spring plate, at one or both ends (2a, 46a) of the male and female mating members that confront the brake disk (50).

9. The anti-theft device according to any one of claim 1 to 8 wherein said coupling means (28) project from the face (2a) turned towards the handlebar means (62) and are retractable from that face so as to allow said face to be flush against the brake disk when locked onto the latter.

10. The anti-theft device according to any one of claims 1 to 9 wherein said locking means 8a, 8b) are also operative to lock said device onto complementary locking elements on the handlebar means (62) or a handlebar adaptor (60), whereby said device can be lockably mounted onto the handlebar using the same lock mechanism (8a, 8b) as for locking onto a brake disk (50).

11. The anti-theft device according to claim 10, wherein said handlebar coupling means (28) engages with the handlebar (62) or a handlebar adaptor (60) by effecting a predetermined movement with respect to the latter, said device further comprising linking means (92, 84; 93-96) which cooperate with the lock mechanism (8a, 8b) for selectively engaging and disengaging the handlebar coupling means with respect to an accessible part of the anti-theft device, e.g. the main body portion (2), so that the latter can impart said predetermined movement to the handlebar coupling means only when the lock is in the unlocked state.

12. The anti-theft device according to claim 10, wherein said handlebar coupling means are in the form of a set of male elements (93) which are mechanically coupled to the lock mechanism (8a, 8b) and configured to be able to project and fasten into corresponding female elements (91) in the handlebar means (62) or handlebar adaptor (60) and to retract therefrom when the lock is respectively in the locked and unlocked state.

13. An anti-theft theft device kit comprising : an anti-theft device (2, 4;4') according to any preceding claim ; and a handlebar adaptor (60) for receiving said anti-theft device at an end of a handlebar means (62) whereby said anti-theft device functions as a handlebar end-piece, said adaptor comprising a sleeve portion (64) insertable inside said handlebar, coupling means (66; 108; 124) complementary to said coupling means (28; 93) of said anti-theft device and means (70-80) for securing said sleeve to said handlebar.

14. The anti-theft device kit according to claim 13, wherein said coupling means (66; 108; 124) are adapted to cooperate with the locking means as set forth in any one of claims 9 to 11.

15. A handlebar means (62) for a vehicle equipped with a handlebar and a disk brake, characterised in that it comprises coupling means specifically adapted to allow mounting of at least one anti-theft device (2,4) as set forth in any one of claims 1 to 12 at one or both ends thereof such that said anti-theft device(s) function(s) as one or both end-piece(s) for said handlebar.

16. An alarm system for a vehicle equipped with handlebar means (62) and at least one brake disk (50) presenting perforations (52) therein or openings at the disk support structure, characterised in that it comprises :

at least one anti-theft device according to any preceding claim and handlebar coupling means (60) therefor allowing said anti-theft device to function as one or both end-piece(s) for said handlebar means (62), and

detection means (140-148; 150-172) for actively signalling if the anti-theft device is not positioned as a handlebar end-piece when attempting to start the vehicle.

17. The alarm system according to claim 16, wherein said anti-theft device (2,4) cooperates with said detection means (140-148) by closing a circuit connection formed at an end of said handlebar means (62) or handlebar adaptor (60) to which the anti-theft device is to be received, said connection being adapted to enable operation said signalling means all the while an anti-theft device is not positioned – or not positioned correctly - on said handlebar means or said handlebar adaptor.

18. The alarm system according to claim 16, wherein said anti-theft device (2,4) further comprises coding means (156) configured to transmit a stored code to said detection means (150-172) and thereby disable the signalling means only when said anti-theft device is correctly installed as an end-piece of the handlebar.

19. An anti-theft device, anti-theft device kit, handlebar means or alarm system substantially as set forth in the description.

20. An anti-theft device, anti-theft device kit, handlebar means or alarm system substantially as illustrated in the figures.

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Claims searched: 1-20 **Date of search:** 24 May 2001

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B7E (ESB)
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Int Cl (Ed.7): B60R (25/00)
B62H (5/00, 5/14, 5/18)
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E05B (67/00, 67/36, 71/00)

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	WO 95/12046	DIAMOND FLEX	-
X	US 5752416	NIEN See whole document.	1-5, 10, 15
A	US 5736924	SHIEH	-
X	US 5289704	JOHNSON See whole document, especially col 6, ln 11-17.	1-4, 15
X	US 4870843	LUNDBERG See whole document.	1-5, 15
X	US 4186576	MEANS et al. See whole document.	1-4, 10, 15

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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